THE PHOTOGEOLOGIC MAPPING OF NORTHERN VENUS; A. T. Basilevsky[1], G. A. Burba[1], M. A. Ivanov[1], V. P. Kryuchkov[1], A. A. Pronin[1], N. N. Bobina[1], V.P. Shashkina[1], and J. W. Head[2]; 1-Vernadsky Institute, Russian Academy of Sciences, Moscow 117975 Russia, abasilevsky@glasnet.ru, 2-Department of Geological Sciences, Brown University, Providence, RI 02912, James_Head_III@Brown.edu

INTRODUCTION. This paper presents the results of an ongoing project of the geologic mapping of Venus of 1:10M scale made as a joint effort of Vernadsky Institute and Brown University. The work is being done based on photogeological analysis of the Magellan images, both in hard copies and in digital format. The total number of map sheets covering all the planet will be 24. This paper is a progress report summarizing the results of mapping the first six map sheets covering the part of Venus north of 35oN.

REGIONAL STRATIGRAPHY. As a preliminary stratigraphic basis for the mapping, the model of regional and global stratigraphy of Venus of Basilevsky & Head (1995a,b,c) was used. In the process of photogeologic analysis and mapping this model was tested independently on each of six sheets. It was checked whether the geologic units suggested by Basilevsky & Head (1995a,b,c) can be identified within this given area and what changes of the model should be made to fit the observed geology. During the mapping and especially after its completion we made cross-correlation of all the geologic units identified within all the mapped area which is about 17.5% of Venus surface. Following is a short description of the resulting stratigraphic sequence for the studied area (from older to younger):

1. Tessera terrain materials (Tt). They are heavily modified by multiple deformation into extremely rough ridge and valley terrain. They are mapped as a single geologic unit although in more detailed studies different varieties of tessera terrain observed in the area might be mapped at least as different structural facies (e.g. Hansen & Willis, 1996). Tessera is embayed and overlain by all other geologic units (except unit 1a) and that establishes its lowest stratigraphic position. The true stratigraphic rank of Tt materials is not clear. Depending on whether these materials were emplaced within a certain relatively short time period or are an assemblage of materials formed at essentially different times, Tt materials may be equivalent in the stratigraphic rank to the majority of the overlaying geologic units or may be a kind of analog of the Precambrian assemblage of the basement of some continental platforms of Earth.

1a. Mountain belts materials (M). They compose the mountain belts surrounding Lakshmi Planum. These belts geomorphologically merge through gradual change of their patterns into adjacent tessera. The pre-plains age of the belts is directly established by their embayment by the surrounding plains. In Maxwell Montes massif two subunits of M materials, with relatively higher and lower backscatter, were distinguished as first done by Basilevsky (1995).

2. Materials of densely fractured terrains of plains (Pdf). These materials are deformed by dense swarms of faults, but ignoring the faults the terrain composed of these materials appears to be primarily plains. Pdf materials are observed as islands embayed by different varieties of ridged and unridged plains described below. Pdf materials often compose, at least partly, the annulus and core of many coronae, but they are equally frequent without association with coronae too. In some areas up to three subunits of Pdf materials were distinguished based on the superposition relations. The first two are rather close in their stratigrapphic position both being correlative to the Pdf unit of Basilevsky & Head (1995a,b,c). The third was found to be stratigraphically correlative to the Pwr plains, representing the case when those plains were deformed by faults in a manner resembling the structural pattern of "normal" Pdf but not reaching the fault density typical for "normal" Pdf.

3. Material of fractured and ridged plains and ridge belts (Pfr/RB). This plains-forming material was primarily smooth but then deformed locally by broad ridges. It contains also fractures, partly as new deformation, partly as inclusions of older Pdf. Sometimes these ridges form clusters that make the terrain ridge belts (RB). Pfr/RB material typically forms islands among the younger plains.

4. Material of plains with wrinkle ridges (Pwr). This material because of its high (~50%) abundance in the area under study forms a kind of background embaying outcrops of older materials and being locally overlain by younger ones. It was traced by mapping through all the area, thus playing the role of continuous stratigraphic marker. Different mappers distinguished within this geologic unit from 2 to 4 subunits. The majority of these plains are "covered" by the single net of wrinkle ridges though in some rather rare cases the earlier episode of wrinkle ridging was also identified.

5. Material of shield plains (Psh). It consists of clusters of small volcanic shields some of which obviously predate Pwr plains, some obviously postdate, and many are in ambiguous age relations with Pwr plains. Wrinkle ridges are rare on these plains either because they mostly postdate the wrinkle ridging or because their rheology was not favorable for their deformation.

6. Material of fracture belts (FB). It is the material of belt-like swarms of fractures typically sitting among the Pwr plains. Thorough mapping shows that part of those fractures predated the Pwr plains, part postdated them, but typically they are so dense and closely interfingering that we found it worthwhile to map these swarms as a geologic unit which may include the materials of Pwr plains and the underlying Pfr/RB and Pdf plains.

7. Materials of smooth plains (Ps) and lobate plains (Pl). They tend to be associated with relatively young (deforming Pwr plains) rift zones forming either areas of practically horizontal plains or gentle sloping mountains such as Renpet Mons. They are also often observed in association with coronae. These materials embay and cover all described above geologic units and are covered in some places by the materials associated with the youngest impact craters. Different mappers identified up to two subunits of the Ps plains and up to two subunits of the Pl plains.

8. Crater materials (Cu). They form walls, floors, central peaks, inner rings, ejecta, and outflows of impact craters. Although in some rare cases (e.g. for crater Deken, 47.10oN, 288.35oE) it was possible to determine the concrete stratigraphic position of the crater, for most of them we could determine only that they are superposed on a certain geologic unit (mostly on Pwr plains) and in five sheets we have mapped all the crater materials as a single geologic unit. On one of the sheets the crater outflows were mapped separately from other crater materials.

9. Materials associated with young impact craters. They form dark parabolas, dark halos, and dark and relatively bright areas of irregular form, all associated with impact craters. At least part of them are the youngest materials of the area under study. Their mapping was the least coordinated among the mappers so some of them showed these materials as normal geologic units, some used hatching, some just ignored them.

Following Basilevsky & Head (1995a,b,c) and Basilevsky et al., (1997) we combine geologic units 1 and 1a into the oldest Fortuna Group, units 2 to 7 into the Guinevere Supergroup subdividing the latter into Sigrun Group (unit 2), Lavinia Group (unit 3), Rusalka Group (units 4 and 5) and Atla Group (unit 7). Unit 6 may combine Sigrunian, Lavinian, and Rusalkian materials. Unit 9 represents the youngest Aurelian Group. Impact crater materials (unit 8) may represent materials belonging to any of the Groups. But because most of them are superposed on the Pwr plains and do not have associated dark parabolas, the majority of the observed impact craters formed obviously during the Atlian time.

CORONAE. In the mapped area there are about 60 coronae. Mapping them most of the mappers did not use special geologic units so the annulae of the majority of coronae were found to be made of Pdf or Pfr/RB materials with the appropriate structural pattern. In some cases the annulae were made of Pwr materials with structural outlines made of wrinkle ridges or relatively young fractures. One of the mappers introduced a special unit (Corona annulus materials) which was found to be stratigraphically correlative to the Pfr/RB unit.

DISCUSSION AND CONCLUSION. Mapping this significant in area (~1/6 of the planet's surface) and continuous region allowed us to trace at least one geologic unit (Pwr plains) through all the mapped territory and to be convinced that other geologic units of the area are in consistent age relations with this unit in any place of this region. To describe the geology of the mapped region we had to make very minor changes in the model of regional and global stratigraphy of Venus by Basilevsky & Head (1995a,b,c) and Basilevsky et al. (1997): to add two more geologic units (Psh and FB) and to subdivide some of the units into subunits. This means that this model and the related scenario of the geologic history of Venus are generally applicable to this region; that is a significant step in testing the model globally.

THE WORK TO BE FINISHED. By the time of the conference we plan to progress more in studying the geology of the mapped territory including estimates of the areas occupied by different geologic units, determination of crater densities on the most extensive of them, and deducing the scenario of key geologic events on the mapped territory.

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